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RADIATIVE CORRECTIONS TO THE $Zb\bar{b}$ and $Z\tau^+\tau^-$ VERTICES IN A REALISTIC ONE-FAMILY EXTENDED TECHNICOLOR MODEL

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Abstract

In a realistic effective one-family extended technicolor(ETC) model without exact custodial symmetry, we calculate the one-loop corrections to the $Zb\bar{b}$ and $Z\tau^+\tau^-$ vertices from the sideways and diagonal ETC bosons exchange. The result shows that both the $Z \to b\bar{b}$ partial width Γ_b (and branching ratio R_b) and the τ polarization asymmetry parameter A_τ are enhanced by the corrections and are in agreement with the present experimental data.

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1 Introduction

Technicolor(TC) models[1] can give contributions to electroweak observables. The precision measurements of electroweak observables give strong constraints on TC models. The general approach to confront TC models with precision measurements is based on the parametrization of the vacuum polarizations and vertex corrections. Specifically, the constraints are characterized by the three independent parameters S, T, and U[2] (or $\epsilon_{1,2,3}$)[3] in the oblique corrections and the corrections to the $Zb\bar{b}$ [4,5] and $Z\tau^+\tau^-$ [6] vertices. It has been shown[2] that one-family TC models with exact custodial symmetry seem to be already excluded by the experimental value of the parameter S. However, as is shown in Ref.[7], this is not the case for TC models without exact custodial symmetry. A realistic model is proposed for a one-family TC model in Ref.[7]. In this model, isospin is a good approximate symmetry only for techniquarks but is broken for technileptons. Such an isospin splitting can contribute to the parameter S with negative sign without making a large contribution to the parameter T. Recently, it has been shown that this kind of ETC model[8] can further explain the puzzling feature of the quark-lepton mass spectrum.

The "high-energy" (heavy TC particle) contributions to the $Zb\bar{b}$ vertex from "integrating out" technifermions have been given in Refs.[4] and [5]. These contributions decrease the $Zb\bar{b}$ branching ratio R_b and are large , even in walking technicolor models[9]. There are also "low-energy" (light TC particle) contributions to the $Zb\bar{b}$ vertex coming from the Pseudo Goldstone bosons (PGB's). For one-family TC model with exact custodial symmetry, the effects have been found to decrease R_b by a few percent[10]. The current LEP data [11] is likely to exclude TC models if the top mass is $100Gev$ or greater. Noncommuting ETC models [12] have been proposed to give a positive correction to the ratio R_b. But it is important to consider at the same time the S parameter. More recently it has been found[13] that an extra gauge boson existing in certain types of dynamical electroweak symmetry breaking models can also give positive corrections to R_b and the τ polarization asymmetry parameter A_τ.

In this paper we reconsider and carefullly calculate the non-oblique corrections to the $Zb\bar{b}$ and $Z\tau^+\tau^-$

vertices from ETC dynamics in a one-family ETC model without exact custodial symmetry. The purpose of this paper is to study the phenomenological aspect of the ETC theory without concerning explicitly the ETC model. So we simply adopt the realistic toy model description of Ref.[5] in our calculation, in which the right-handed top quark and bottom quark are put in the same representation and their mass difference are described by assigning different effective ETC coupling constants to them. We find that the sideways ETC boson exchange decreases the width $\Gamma_b = \Gamma(Z \to b\bar{b})$ and $R_b = \frac{\Gamma_b}{\Gamma_h}$, while the diagonal ETC boson exchange increases Γ_b and R_b which is contrary to the result in Ref. [5]. In this kind of model [7], the decay constant of the technipion in the technilepton sector is significantly smaller than that in the techniquark sector. So the corrections to the $Z\tau^+\tau^-$ vertex is much smaller than the corrections to the $Zb\bar{b}$ vertex. However, we find that the correction to the τ asymmetry parameter A_τ is positively enhanced and is in agreement with the present experimental data.

This paper is organized as follows. In Sec.II we discuss the masses of quarks and leptons in a realistic effective one-family ETC model. The calculations of the corrections to the $Zb\bar{b}$ vertex and the τ polarization asymmetry parameter A_τ from the ETC boson exchanges will be presented in Sec.III and Sec.IV, respectively. Sec.V is a concluding remark.

2 The Masses of Quarks and Leptons

To generate the masses of quarks and leptons, the ETC gauge group $SU(N_{TC}+1)$ is assumed to hierarchically break down to the TC gauge group $SU(N_{TC})$. In this process many ETC gauge bosons become massive. Some of them mediating ordinary fermions with technifermions are called sideways bosons and some of them mediating the same kind of fermions are called "diagonal" bosons. The sideways ETC bosons must exist in any realistic ETC models to generate the masses of quarks and leptons, while the existence of diagonal ETC bosons is model-dependent. In the present model, there are both knds of ETC bosons.

The approximate global chiral symmetry of the present one family model is $G = SU(6)_L \times SU(6)_R \times U(1)_{2R} \times U(1)_{8L} \times U(1)_{8R} \times U(1)_V$ [7]. The mass spectrum of technifermions is

$$(a), M_U \approx M_D, \qquad\qquad (b) M_N < M_E < M_U$$

These technifermions can be assigned to the following representations of $SU(3)_C \times SU(2)_L \times U(1)_Y \times SU(N_{TC})$

$$Q_L = (U, D)_L = (3, 2, \frac{Y_{Lq}}{2}, N_{TC}), U_R = (3, 1, \frac{Y_{Lq}}{2} + \frac{1}{2}, N_{TC})$$

$$D_R = (3, 1, \frac{Y_{Lq}}{2} - \frac{1}{2}, N_{TC}), L_L = (N, E)_L = (1, 2, \frac{Y_{Ll}}{2}, N_{TC})$$

$$E_R = (1, 1, \frac{Y_{Ll}}{2} - \frac{1}{2}, N_{TC}), N_R = (1, 1, \frac{Y_{Ll}}{2} + \frac{1}{2}, N_{TC}),$$

where $Y_{Lq} = \frac{1}{3}$ and $Y_{Ll} = -1$ are the hypercharges of the left-handed techniquark and technilepton, respectively.

The lagrangian in the model describing the sideways ETC gauge interaction between the third family fermion and technifermion is[5],[6]

$$L = g_E(\xi_t \overline{Q_L} W_E^{\nu} \gamma_{\nu} q_L + \xi_{Rt} \overline{U_R} W_E^{\nu} \gamma_{\nu} t_R + \xi_b \overline{D_R} W_E^{\nu} \gamma_{\nu} b_R + h.c.$$

$$+ \xi_{\tau} \overline{L_L} W_E^{\nu} \gamma_{\nu} l_L + \xi_{\nu} \overline{N_R} W_E^{\nu} \gamma_{\nu} \nu_R + \xi_{R\tau} \overline{E_R} W_E^{\nu} \gamma_{\nu} \tau_R + h.c.), \tag{1}$$

where $q_L = (t, b)_L, t_R$ and b_R represent the third family of quarks, $l_L = (\nu, \tau)_L, \nu_R$ and τ_R represent the third family of leptons, W_E is the sideways ETC boson coupling to the third family ordinary fermions and technifermions with the coupling constant g_E, and ξ_i is the coefficient of the left-handed or right-handed couplings [6]. The summation over the color index is implied in (1).

Using the rules of naive dimensional analysis [14], the ordinary fermion mass can be written as $m_i = \frac{g_E^2}{m_E^2}(4\pi f_i^3)$. From (1) the masses of ordinary fermions are given as

$$m_t = \xi_t \xi_{Rt} \frac{g_E^2}{m_S^2} < \overline{U} U >= \xi_t \xi_{Rt} \frac{g_E^2}{m_S^2} 4\pi f_Q^3 \tag{2}$$

$$m_b = \xi_t \xi_b \frac{g_E^2}{m_S^2} < \overline{D} D >= \xi_t \xi_b \frac{g_E^2}{m_S^2} 4\pi f_Q^3 \tag{3}$$

$$m_\nu = \xi_\tau \xi_\nu \frac{g_E^2}{m_S^2} < \overline{N} N >= \xi_\tau \xi_\nu \frac{g_E^2}{m_S^2} 4\pi f_N^3 \tag{4}$$

$$m_\tau = \xi_\tau \xi_{R\tau} \frac{g_E^2}{m_S^2} < \overline{E} E >= \xi_\tau \xi_{R\tau} \frac{g_E^2}{m_S^2} 4\pi f_E^3, \tag{5}$$

where m_S is the mass of the sideways ETC boson, and f_Q, f_E, f_N are the decay constants of technipions composed of techniquarks, technielectron and technineutrino, respectively.

In one-family TC models with custodial symmetry, the technipion decay constant is $4F_\pi^2 = (250Gev)^2$. In models without custodial symmetry, the decay constant in the technileption sector is different from that in the techniquark sector. They satisfy the following constraint:[7]

$$N_C f_Q^2 + \frac{1}{2} f_N^2 + \frac{1}{2} f_E^2 \approx (250Gev)^2, \tag{6}$$

where $N_C = 3$ is the number of colors in QCD. In the realistic one-family TC model[7], the decay constants are taken to be $N_C f_Q^2 \gg \frac{1}{2}(f_N^2 + f_E^2)$ in order to keep the electroweak parameter S small or even negative without violating the experimental bound on the parameter T.

For given quark and lepton masses, we see from (2)-(5) that the ξ_i's should have the relations

$$\xi_t = \xi_{Rt}^{-1}, \qquad \xi_b = \xi_t^{-1} \frac{m_b}{m_t} \tag{7}$$

$$\xi_\tau = \xi_{R\tau}^{-1}, \qquad \xi_\nu = \xi_\tau^{-1} \frac{m_\nu}{m_\tau}. \tag{8}$$

If we take $m_t = 175Gev, m_b = 4.8Gev$, and $m_\nu \approx 0$, we have $\xi_b \approx 0.028 \xi_t^{-1}$ and $\xi_\nu \approx 0$.

3 Corrections to the $Zb\bar{b}$ Vertex

The corrections to the $Zb\bar{b}$ vertex can come from sideways ETC boson exchange and diagonal ETC boson exchange. From (1) , the effective four-fermion operators from sideways ETC boson exchange are

$$-\frac{g_E^2}{m_S^2} [\xi_t^2 (\overline{Q_L} \gamma^\nu q_L)(\overline{q}_L \gamma_\nu Q_L) + \xi_b^2 (\overline{D_R} \gamma^\nu b_R)(\overline{b_R} \gamma_\nu D_R)] \tag{9}$$

We can further make Fierz reordering to express the four-fermion operators in terms of quark-quark currents and techniquark-techniquark currents. Note that only color-singlet currents can couple to the Z-boson, and are thus relevant to the $Zb\bar{b}$ vertex. The piece composed of color-octet currents is irrelevant to the present study. After Fierz reordering, the relevant four-fermion operators are

$$-\frac{g_E^2}{2m_S^2}\frac{1}{N_C}[\xi_t^2(\overline{Q_L}\gamma^\nu\tau^a Q_L)(\overline{q_L}\gamma_\nu\tau^a q_L)+\xi_b^2(\overline{D_R}\gamma^\nu D_R)(\overline{b}_R\gamma_\nu b_R)], \tag{10}$$

where color and technicolor summation is implied and $\tau^a (a=1,2,3)$ are weak isospin Pauli matrices.

Adopting an effective chiral lagrangian description which is appropriate below the technicolor chiral symmetry breaking scale, the technifermion current may be replaced by the corresponding sigma model current[15].

$$(\overline{Q_L}\gamma_\nu\tau^a Q_L)=\frac{N_C f_Q^2}{2}Tr(\Sigma^+\tau^a iD_{\nu L}\Sigma) \tag{11}$$

$$(\overline{D_R}\gamma_\nu D_R)=\frac{N_C f_Q^2}{2}Tr(\Sigma iD_{\nu R}\Sigma^+), \tag{12}$$

where $\Sigma=exp(\frac{2i\phi}{f_Q})$ transforms as $\Sigma\to L\Sigma R^+$ under $SU(2)_L\times SU(2)_R$, ϕ is the Nambu - Goldstone boson field, and the covariant derivatives $D_{\nu L}$ and $D_{\nu R}$ are

$$\begin{aligned} D_{\nu L}\Sigma &= \partial_\nu\Sigma+i\frac{e}{\sqrt{2}S_\theta}(W_\nu^+\tau^++W_\nu^-\tau^-)\Sigma \\ &+i\frac{e}{S_\theta C_\theta}Z_\nu(\frac{1}{2}\tau_3\Sigma-S_\theta^2[Q,\Sigma])+ieA_\nu[Q,\Sigma], \end{aligned} \tag{13}$$

$$D_{\nu R}\Sigma=\partial_\nu\Sigma-i\frac{e}{S_\theta C_\theta}Z_\nu(\frac{1}{2}\tau_3\Sigma+C_\theta^2\{Q,\Sigma\})+ieA_\nu[Q,\Sigma]. \tag{14}$$

In the unitary gauge $\Sigma=1$, we can give the terms which are relevant to the $Zb\bar{b}$ vertex from the operator (10),

$$\frac{g_E^2}{2m_S^2}\frac{f_Q^2 e}{S_\theta C_\theta}[\xi_t^2\overline{q_L}Z\frac{\tau_3}{2}q_L-\xi_b^2\overline{b_R}Z\frac{\tau_3}{2}b_R], \tag{15}$$

where $S_\theta=\sin\theta, C_\theta=\cos\theta$ with θ being the Weinberg angle. These yield the corrections to the tree-level standard model $Zb\bar{b}$ couplings

$$g_L^b=\frac{e}{S_\theta C_\theta}(-\frac{1}{2}+\frac{1}{3}S_\theta^2), \qquad g_R^b=\frac{e}{S_\theta C_\theta}(\frac{1}{3}S_\theta^2). \tag{16}$$

The corrections are

$$\delta g^b_{LS} = \frac{\xi_t^2}{4}\frac{g_E^2 f_Q^2}{m_S^2}\frac{e}{S_\theta C_\theta} = \frac{\xi_t^2}{4}\frac{m_t}{4\pi f_Q}\frac{e}{S_\theta C_\theta}, \tag{17}$$

$$\delta g^b_{RS} = -\frac{\xi_b^2}{4}\frac{g_E^2 f_Q^2}{m_S^2}\frac{e}{S_\theta C_\theta} = -\frac{\xi_b^2}{4}\frac{m_t}{4\pi f_Q}\frac{e}{S_\theta C_\theta}. \tag{18}$$

Since the tree level $Zb_L\overline{b_L}$ coupling g^b_L is negative and $Zb_R\overline{b_R}$ coupling g^b_R is positive, we see that the sideways ETC boson exchange corrections decrease the width Γ_b relative to the standard model prediction. This is disfavored by the recent precision electroweak measurements.

Aprt from the sideways boson contributions, there are also diagonal boson contributions in the present realistic model[5]. For a given technicolor number N_{TC}, we can obtain the diagonal coupling of technifermions by multiplying the factor $\frac{1}{\sqrt{N_{TC}(N_{TC}+1)}}$ to their sideways coupling, and that of ordinary fermions by multiplying the factor $-\sqrt{\frac{N_{TC}}{N_{TC}+1}}$ to their sideways coupling. These factors come from the normalization of the tranceless diagonal generator. The diagonal boson exchange gives rise to the following four-fermion operators

$$(\frac{m_S}{m_D})^2\frac{g_E^2}{2m_S^2}\frac{1}{N_{TC}+1}[(\overline{U_R}\gamma^\nu U_R)(\overline{q_L}\gamma_\nu q_L) + \xi_t\xi_b(\overline{D_R}\gamma^\nu D_R)(\overline{q_L}\gamma_\nu q_L)$$

$$+\xi_t^{-1}\xi_b(\overline{U_R}\gamma^\nu U_R)(\overline{b_R}\gamma_\nu b_R)]. \tag{19}$$

Similar to (17) and (18), we obtain the following corrections to g^b_L and g^b_R from the diagonal ETC boson exchange

$$\delta g^b_{LD} = -\frac{1}{4}\frac{m_t}{4\pi f_Q}\frac{e}{S_\theta C_\theta}(\frac{m_S}{m_D})^2\frac{N_C}{N_{TC}+1}\xi_t(\xi_t^{-1}+\xi_b), \tag{20}$$

$$\delta g^b_{RD} = -\frac{1}{4}\frac{m_t}{4\pi f_Q}\frac{e}{S_\theta C_\theta}(\frac{m_S}{m_D})^2\frac{N_C}{N_{TC}+1}\xi_t^{-1}\xi_b. \tag{21}$$

We see that the diagonal ETC boson exchange gives negative corrections to both g^b_L and g^b_R, and its total effect is to increase Γ_b and R_b contrary to that from the sideways ETC boson exchange. This result differs from that in Ref.[5] by a minus sign (ref[16] gives the similar conclusion). Note that δg^b_{LD} and δg^b_{RD} decrease as N_{TC} increases. Furthermore, we see from (18), (21), and (7) that δg^b_{RS} and

δg^b_{RD} are suppressed by $(\frac{m_b}{m_t})^2$ and $(\frac{m_b}{m_t})$, respectively. Therefore, δg_{RD} is more important than δg_{RS}, and can not be ignored.

Summing up the corrections to the $Zb\bar{b}$ vertex from the sideways and diagonal ETC boson exchange , we obtain the total correction

$$\delta g^b_{LE} = -\frac{1}{4}\frac{m_t}{4\pi f_Q}\frac{e}{S_\theta C_\theta}[(\frac{m_S}{m_D})^2\frac{N_C}{N_{TC}+1}\xi_t(\xi_t^{-1}+\xi_b) - \xi_t^2], \tag{22}$$

$$\delta g^b_{RE} \approx -\frac{1}{4}\frac{m_t}{4\pi f_Q}\frac{e}{S_\theta C_\theta}(\frac{m_S}{m_D})^2\frac{N_C}{N_{TC}+1}\xi_t^{-1}\xi_b. \tag{23}$$

We see that that magnitudes of these two corrections are comparable. For large N_{TC}, the sideways ETC boson exchange contribution to δg^b_{LE} may dominate. However, m_S/m_D is a model-dependent parameter. Therefore, it is possible to have a realistic model leading to positive corrections to δg^b_{LE} and δg^b_{RE}.

Having (22) and (23), we obtain the following total corrections to Γ_b and R_b

$$(\frac{\delta\Gamma}{\Gamma_b})_E = \frac{2(g^b_L\delta g^b_{LE} + g^b_R\delta g^b_{RE})}{g^{b2}_L + g^{b2}_R}$$

$$\approx +1.26\%(\frac{m_t}{175Gev}), \tag{24}$$

$$\delta R_{bE} = \delta(\frac{\Gamma}{\Gamma_b})_E = (\frac{\delta\Gamma}{\Gamma_b})_E(\frac{\Gamma_b}{\Gamma_h})(1-\frac{\Gamma_b}{\Gamma_h})$$

$$\approx +0.99\%(\frac{m_t}{175Gev})R_b. \tag{25}$$

In (24) and (25), we have take $\xi_t \approx \frac{1}{\sqrt{2}}, \xi_b \approx 0.028\xi_t^{-1}, N_{TC} = 4, f_Q \approx 143Gev$ and $m_S \approx m_D$.

For the ratio R_b, all oblique corrections and the leading QCD corrections cancel. δR_{bE} is the pure nonolique correction to the the $Zb\bar{b}$ vertex. The recent measurement of R_b at the CERN e^+e^- collider LEP[11] gives $R_b = 0.2202 \pm 0.0020$ which is larger than the standard model predicted value $R_b^{SM} = 0.2157 \pm 0.0004$ by more than two standard deviations. So the above result in (25) is particularly interesting.

So far we have focused on the " high energy" technicolor corrections to the $Zb\bar{b}$ vertex from ETC boson exchange, there are still " low energy " corrections coming from the PGB's[10]. However, the masses of the PGB's could be significantly enhanced in the realistic one-family ETC model, so that the PGB's correction to R_b could be significantly reduced and could thus be ignored.

4 Corrections to the $Z\tau^+\tau^-$ Vertex

Now we calculate the corrections to the $Z\tau^+\tau^-$ vertex from the sideways and diagonal ETC boson exchanges. We particularly estimate the effect of these corrections on the τ polarization asymmetry parameter $A_\tau = \frac{(g_L^\tau)^2-(g_R^\tau)^2}{(g_L^\tau)^2+(g_R^\tau)^2}$ whose experimental value serves as the best constraint on the $Z\tau^+\tau^-$ vertex.

From (1) we can write down the four-fermion operators contributing to the $Z\tau^+\tau^-$ vertex from the sideways ETC boson exchange. After Fierz transformation it becomes

$$-\frac{g_E^2}{2m_S^2}[\xi_\tau^2(\overline{L_L}\tau^a\gamma^\nu L_L)(\bar{l}_L\gamma_\nu\tau^a l_L)+\xi_\tau^{-2}(\overline{E_R}\gamma^\nu E_R)(\overline{\tau_R}\gamma_\nu\tau_R)]. \tag{26}$$

Similar to the derivation of (19), we can also obtain the four-fermion operators from the diagonal ETC boson exchange

$$(\frac{m_S}{m_D})^2\frac{g_E^2}{2m_S^2}\frac{1}{N_{TC}+1}\{(\overline{E_R}\gamma^\nu E_R)(\overline{l_L}\gamma_\nu l_L)+\xi_\tau[\xi_t^{-1}(\overline{U_R}\gamma^\nu U_R)+\xi_b(\overline{D_R}\gamma^\nu D_R)](\overline{l_L}\gamma_\nu l_L)$$

$$+\xi_\tau^{-1}[\xi_t^{-1}(\overline{U_R}\gamma^\nu U_R)+\xi_b(\overline{D_R}\gamma^\nu D_R)](\overline{\tau_R}\gamma_\nu\tau_R)\}. \tag{27}$$

By means of the effective lagrangian approach we can obtain the corrections to the tree-level vertex of $Z\tau^+\tau^-$ coupling

$$g_L^\tau=\frac{e}{S_\theta C_\theta}(-\frac{1}{2}+S_\theta^2), \qquad g_R^\tau=(\frac{e}{S_\theta C_\theta})S_\theta^2, \tag{28}$$

which are

$$\delta g_{LE}^\tau=-\frac{1}{4}\frac{m_t}{4\pi}\frac{1}{f_Q}\frac{e}{S_\theta C_\theta}[-\frac{f_E^2}{f_Q^2}\xi_\tau^2+(\frac{m_S}{m_D})^2\frac{N_C}{N_{TC}+1}\xi_\tau(\xi_t^{-1}+\xi_b+\frac{f_E^2}{N_C f_Q^2}\xi_\tau^{-1})], \tag{29}$$

$$\delta g_{RE}^{\tau} \approx -\frac{1}{4}\frac{m_t}{4\pi}\frac{1}{f_Q}\frac{e}{S_\theta C_\theta}[-\frac{f_E^2}{f_Q^2}\xi_\tau^{-2} + (\frac{m_S}{m_D})^2\frac{N_C}{N_{TC}+1}\xi_\tau^{-1}(\xi_t^{-1}+\xi_b)]. \tag{30}$$

Considering the relation $f_Q^2 \gg f_E^2$ the above results can be approximately written as

$$\delta g_{LE}^{\tau} = -\frac{1}{4}\frac{m_t}{4\pi}\frac{1}{f_Q}\frac{e}{S_\theta C_\theta}(\frac{m_S}{m_D})^2\frac{N_C}{N_{TC}+1}\xi_\tau(\xi_t^{-1}+\xi_b), \tag{31}$$

$$\delta g_{RE}^{\tau} \approx -\frac{1}{4}\frac{m_t}{4\pi}\frac{1}{f_Q}\frac{e}{S_\theta C_\theta}(\frac{m_S}{m_D})^2\frac{N_C}{N_{TC}+1}\xi_\tau^{-1}(\xi_t^{-1}+\xi_b). \tag{32}$$

The relative correction $\frac{\delta A_\tau}{A_\tau}$ can be expressed in terms of δg_L^τ and δg_R^τ as

$$\frac{\delta A_\tau}{A_\tau} = \frac{4(g_L^\tau)^2(g_R^\tau)^2}{(g_L^\tau)^4-(g_R^\tau)^4}(\frac{\delta g_L^\tau}{g_L^\tau} - \frac{\delta g_R^\tau}{g_R^\tau})$$

$$= -(\frac{e}{S_\theta C_\theta})^{-1}(24.04\delta g_L^\tau + 27.99\delta g_R^\tau). \tag{33}$$

From (32) and (33) we see that $(\frac{\delta A_\tau}{A_\tau}) > 0$. The recent measurement of the parameter A_τ is $\frac{\delta A_\tau}{A_\tau} = 0.31 \pm 0.13$[13]. So the realistic one-family ETC model without custodial symmetry is also consistent with the present experiment of A_τ.

The PGB's correction to the $Z\tau^+\tau^-$ vertex is suppressed by the square of the small τ mass and can thus be ignored[16]. However, there is another large correction from the isospin breaking effect in the tecnileption sector coming from the vector mesons composed of technileptions. The corrections to the $Z\tau^+\tau^-$ vertex coming from neutral techni-vector-mesons can not be simply ignored. In Ref.[6], such correction to the coupling constant g_L^τ has been computed and the difference between the corrections to the $Z\tau_L^+\tau_L^-$ and the $W\tau\nu$ vertices has been given. We shall give a detailed examination of such correction to the coupling constant g_R^τ in our future work.

5 Conclusions

We have calculated the corrections to the $Zb\bar{b}$ vertex and the $Z\tau^+\tau^-$ vertex from ETC boson exchanges in a realistic one-family ETC model with diagonal ETC boson. We have estimated the effect on the $Zb\bar{b}$ couplings from both the sideways ETC boson exchange and the diagonal ETC boson

exchange. We find that the sideways ETC boson exchange decreases the width Γ_b, while the diagonal ETC boson exchange tends to increase it. The two corrections are comparable and the total correction to the $Zb\bar{b}$ vertex gives a positive correction to R_b which is consistent with the present LEP experiment. We have also calculated the corrections to the tree-level vertex of $Z\tau^+\tau^-$ couplings g_L^τ and g_R^τ from the ETC boson exchanges. We find that the correction to g_R^τ is not smaller than that to g_L^τ and can not be ignored. We then give an estimate of $\frac{\delta A_\tau}{A_\tau}$ from the obtained δg_L^τ and δg_R^τ, and find that $\frac{\delta A_\tau}{A_\tau} > 0$ which is also consistent with the present LEP experiment. These conclusions are good to the realistic one-family ETC model[7] . Further improvements of the precise lepton p[olarrization asymmetry measurements will give better constraints to the model.

In this paper, we have compentently analyzed the corrections to the $Zb\bar{b}$ vertex and the $Z\tau^+\tau^-$ vertex due to the different possible ETC gauge exchanges in realistic one - family TC model. The analysis for other TC models may have similar qualitative feataures.

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